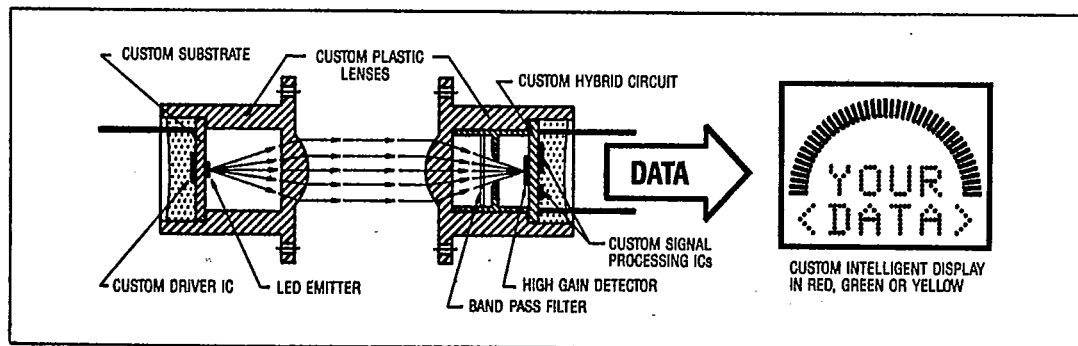


SIEMENS

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CUSTOM OPTOELECTRONIC PRODUCTS

A representative example of our broad custom capabilities described below.

INTRODUCTION

Siemens Custom Optoelectronic Products are designed typically for unique applications or specific performance requirements using optical devices. Because of our over 15 years experience as an optoelectronics supplier, you benefit from this long time experience and tested performance. Our custom engineering resources include an engineering expertise in solid state optical devices and plastic optics, full custom packaging capability, complex hybrid system capability, IC design, and an optical design and measurements lab. Our custom product approach gives you reduced system cost, improved performance, design ownership, improved reliability, high product quality, and many more benefits and features.

OUR CAPABILITIES

- **Optical Design Expertise**
 - Solid State Optical Device Solutions
 - Plastic Lens Capabilities
 - Multi-Element Lens Capability
 - Multi-Channel Fiber Optic Design Techniques
- **Full Range of Custom Packaging Options**
 - Modular Assemblies Designed and Built Using:
 - Custom Leadframes
 - Molded Plastic Optics
 - Hybrid Chip-on-Substrate Assemblies
 - Polymer Thick-Film Multilayer Substrates
 - Transfer Molded Packages
 - Hermetic Packages
- **Specialize in Hybrid Functional Modules**
 - Extensive Chip-On-Board Experience
 - Precise Die Positioning in Single Units or Arrays
 - Board Component Design
 - Surface Mount Technology

- **Optical Measurements Facility**
 - Absolute Characterization of Optical Performance
 - Fast and Accurate Responses to Customer Requirements
 - Measurements Traceable to National Bureau of Standards
- **Computer Aided Design Facility**
- **In-House IC Design Capability**
 - High Speed Silicon Gate CMOS and Bipolar Technology
 - Complete IC Test, Process and Product Engineering
- **Quality and Reliability Control**
 - Established QC System
 - Average Quality Level, under 50 PPM
 - Extensive Product Characterization
- **State-of-the-Art Materials**
 - Full Spectrum of Visible LEDs, Infrared Emitters, and Detectors
- **Wafer Fabrication Facility**
 - Complete Control of Device Fabrication
 - State-of-the-Art Process and Materials
 - Custom Die Designs
- **Model, Offshore Assembly Facility**
 - Latest Automated Assembly Equipment
 - Test and Burn-in Capability
 - "Just-in-Time" Philosophy
 - Over 15 Years Experience in Optical Hybrid Assemblies

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CUSTOMER BENEFITS

- **Reduced System and Program Costs**
 - Higher Level of Integration
 - Reduction in Components Required
- **Optimum Product Performance**
 - Use of Latest Technology
 - Improved Optical Design Techniques
- **Uniquely Competitive Designs**
 - Special Functions and Features
 - Proprietary Customer Design
- **Reduced Product Development Time**
 - Allows Quicker Entry to Market
- **Improved Reliability and Quality**

CUSTOM ENGINEERING RESOURCES

Siemens is an expert in evaluating customer requirements and proposing systems solutions. For example, our engineers are specialists at integrating LED displays with microprocessors to form display subsystems.

Also, our expertise in optical engineering allows us to optimize emitter/detector system designs. This includes: unique plastic lens design, multi-element lens designs, multi-channel fiber optics design techniques as well as the use of other optical elements such as apertures, reflectors, mirrors, etc.

CUSTOM PACKAGING AND HYBRID CAPABILITIES

Custom packaging is another option available to you offering a significant size reduction and resulting cost savings over most existing designs. Our modular assemblies are designed and built using custom leadframes, custom molded plastic lenses, hybrid chip-on-substrate assemblies or polymer thick-film multilayer substrates. We have extensive chip-on-board experience for airgap, concoat, and epoxy encapsulated modules. We support air gap assemblies with metal or plastic housings. We also have the technology to transfer mold epoxy packages. For harsh environmental conditions we offer hermetic processing using glass, ceramic or metal assemblies.

Another area of expertise is in precise die positioning in single units or arrays. Our surface mount technology supports both ceramic and PCB substrates. Our component design capability includes visible LEDs, IR LEDs, Op Amps, Photodiodes, Phototransistors, LSI CMOS Chips, Bipolar ICs, Optocouplers, and Discretes. In summary, we are the optoelectronic specialists in the design of hybrid modules.

OPTICAL DESIGN AND MEASUREMENTS LABORATORY

The Siemens Optics Lab, a versatile and precise optical measurement facility, provides fast and accurate absolute characterization of optical radiation performance. This insures fast and accurate responses to customer requirements and on-site field support available on complex issues. The lab is coordinated with standards organizations worldwide insuring the latest conventions for optical measurement procedures. All measurements are traceable to the National Bureau of Standards.

Listed below are a few of our optical laboratory's capabilities:

- LED spectral irradiance from 280 to 1070 nm.
- LED spectral luminosity from 380 to 780 nm.
- Radiometric and photometric intensity.
- Detector response versus wavelength from 280 to 1070 nm.
- Precise computer based measurement system.
- Other optical capabilities available to support customer needs.

WAFER FABRICATION FACILITIES

For your custom requirements, Siemens wafer fabrication facilities use state-of-the-art materials such as Gallium Arsenide (GaAs), Gallium Aluminum Arsenide (GaAlAs), Gallium Phosphide (GaP), and Gallium Arsenide Phosphide (GaAsP). We can control wavelength in a range from 560 nm to 840 nm. Our quality material gives you higher reliability and more brightness with lower power. We also provide a material foundry service for your custom die requirements.

CAD/CAM: DESIGN AND ASSEMBLY

We design custom assemblies and subassemblies by computer and assemble by computer-controlled automated assembly equipment. This vastly improves the reliability and quality control while offering more features at the lowest possible cost.

AUTOMATED OFFSHORE ASSEMBLY FACILITY

The Siemens assembly plant, in Penang, Malaysia, uses the latest in automated assembly and test equipment allowing effective and flexible approaches to varying technologies and products yielding competitive costs and prices. Our automated computer tracking system supports a "just-in-time" delivery philosophy. A total quality concept includes a statistical process control program, a continuous calibration program, a preventive maintenance program, and an employee job awareness enhancement program is an on-going commitment. A complete test and burn-in facility is supported by a failure analysis group and reliability monitors. Production lots are traceable guaranteeing predictability of quality and yield. A dedicated product development group supports a variety of customer needs. We have accumulated a total of over 14 years experience in the assembly and test of high density optoelectronic hybrid assemblies.

CUSTOMER BENEFITS

Your program benefits in many ways, through a combination of the engineering resources and available technology. We can reduce your system and overall program costs through higher levels of integration, reduced component inventory/ lower component costs, elimination of in-house assembly labor costs, lower inventory costs, reduction of warranty expenses, and lower administrative costs. We can offer optimum product performance with improved optical design techniques using leading edge technology. Our state-of-the-art packaging techniques offer significant size reductions as well as improved operating conditions. All this leads to

Custom
Optoelectronic
Products

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improved product quality and reliability characteristics since the final product is 100% tested and guaranteed operational.

Your design will be uniquely competitive since it will use features and technologies not available to your competitors. The design will be your proprietary product. Our ability to dedicate engineering resources to your custom project frees up your resources for other programs enabling your products quicker introduction to the market. You receive only fully tested and quality assured product (100% yield) for improved reliability and quality.

CUSTOM APPLICATIONS AND MARKETS SERVED

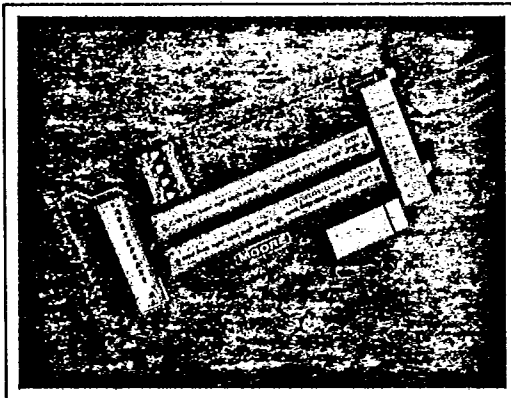
Siemens Custom Products have applications in virtually every OEM market. We currently serve the industrial,

medical, EDP and computer peripherals, telecommunications, office equipment, and transportation markets. Some high volume applications now in production include: medical fluid flow sensor, medical oximetry probes, electronic coin sensing, industrial controller displays, currency validation, computer touch screen sensing, instrumentation panels, sign boards, information of data terminal displays, and custom lamps and bar graphs.

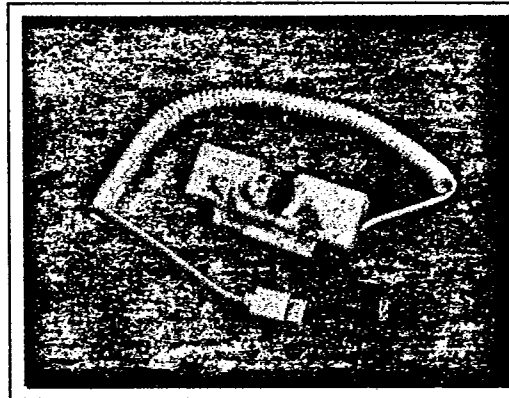
INQUIRIES

Your inquiries should include mechanical, electrical, and environmental requirements. Also include anticipated product volumes, price objectives, and leadtimes since these considerations affect the design and tooling approach.

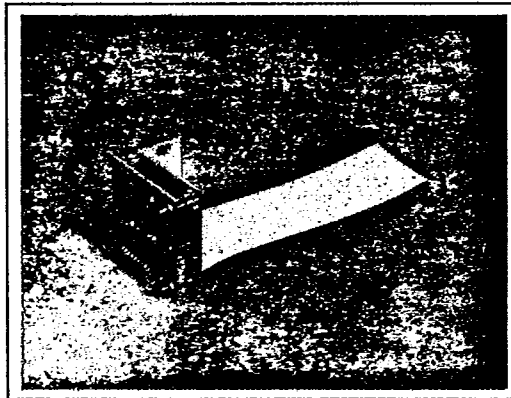
Examples of Products in Production:



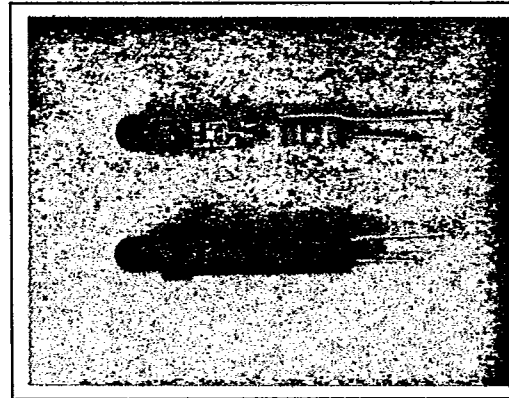
Industrial Display



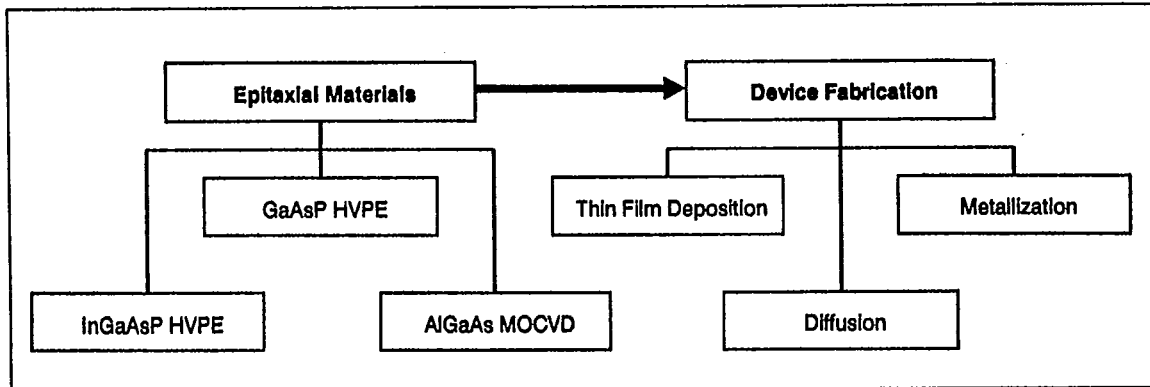
Fluid Flow Sensor



Coin Sensor



Telephone Switch Indicator Lamp

SIEMENSCustom
Optoelectronic
Products**CUSTOM OPTOELECTRONIC MATERIALS AND DIE****Introduction****• Custom Materials Growth**

- State-of-the-Art Proprietary Reactor Designs
- GaAsP, InGaAsP, and AlGaAs Growth Capability
- Complete Materials Analysis Facility
- Systems Handle Prototype & Production Volumes
- 2" and 3" Diameter Wafers and Custom Shapes

• Custom Device Fabrication

- Thermal & Plasma Thin Film Deposition
- Optimized Diffusions for Each Composition
- Customized N- and P-Type Metallizations
- All Processes are DESC/MIL Certified

• In-House Computer-Aided Device Design

- Custom Electro-Optical Devices
- Library of Point-Source, Multi-Segment, and Fiber Optic Designs Available

• Optical Measurements Facility

- Absolute Characterization of Optical Performance
- Fast, Accurate Response to Customer Requests
- All Measurements are NBS-Traceable
- 100% Analytical Test Capability

• Modern Testing and Assembly Facility

- 42,000 sq. ft. Facility in Penang, Malaysia
- Latest Automated Assembly Equipment
- 100% Test and Burn-In Capability
- "Just-in-Time" Philosophy
- Over 14 Years Experience in Optical Hybrid Assemblies

• Additional Product Design Expertise

- Multi-Element Lens Capability
- Multi-Channel Fiber Optic Design Techniques
- Hermetic Packages
- Board Component Design
- Surface Mount Technology

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Epitaxial Materials Growth Facility

For your custom materials requirements, Siemens' epitaxial growth facility offers optoelectronic products in several compound semiconductor systems. We have over 15 years of experience in the growth of GaAsP/GaAs materials. Siemens is recognized worldwide for the superior quality and uniformity of our 655nm "Standard Red" materials, but we also produce and have characterized compositions ranging from 560nm pure green through 840nm Infrared.

In addition, we are actively developing InGaAsP growth by HVPE and AlGaAs growth by metal-organic chemical vapor deposition (MOCVD). InGaAsP finds application in the visible and infrared regions of the spectrum, while AlGaAs is primarily an infrared material by this growth technique. Both materials are well suited for optical detectors.

An important consideration for our customers is the shape and size of the wafers we produce. To that end, Siemens offers a selection of 2" and 3" diameter wafers sized to SEMI specifications or wafers shaped to match your specific needs.

Device Fabrication Facility

Siemens has a fully equipped fabrication facility for processing epitaxial wafers into finished devices. The processes available include thin-film deposition, photolithography, diffusion, metallization, lapping, and parametric testing and analysis. We employ statistical quality control (SQC) to ensure consistency of the most critical processes, and our facility is DESC certified to produce JAN-rated products. In-house control of the fabrication process enables us to select a customized combination of technologies that best match your product needs.

Each application has its own pattern requirements dictated by available drive power, optical output power, human recognition, reliability, etc. Siemens helps you choose from a wide selection of device designs. We maintain a library of extensively characterized standard designs for point-source, multi-segment, and fiber optic emitters, or you can pick your own proprietary configuration. You can apply our design rules to produce your own masks, or give us your mechanical drawing and let us turn it into a working device. We are experienced in the design of large

area, high density devices with as many as 240 uniform emitting areas on a single chip!

If you prefer, Siemens can also produce the fully assembled product by computer design of custom assemblies and sub-assemblies and use of automated manufacturing equipment. This vertical integration vastly improves reliability and quality control while offering more features at the lowest possible cost.

Optical Design and Measurements Laboratory

The Siemens Optics Lab, a versatile and precise optical measurement facility, provides fast and accurate characterization of optical radiation performance. This insures prompt and reliable responses to customer requirements. The lab is coordinated with standards organizations worldwide and employs the latest conventions for optical measurement procedures. All measurements are traceable to the National Bureau of Standards.

Automated Offshore Assembly Facility

The Siemens assembly facility in Penang, Malaysia, uses automated test, dicing, and assembly equipment providing both flexibility in device characterization and highest quality/lowest cost for finished products. The test and burn-in operations are supported by a failure analysis group and reliability monitors. The product is fully traceable back to the raw materials, guaranteeing predictability of quality and yield.

Worldwide Technical Commitment

One of our chief strengths lies in Siemens' commitment to establishing leading-edge semiconductor technologies. Divisions throughout the world are involved in the manufacture of optical components for signal processing, ultrahigh-speed communication, and long haul data transmission. Supporting the efforts are the Corporate Research and Technology Laboratories. They are responsible for research in evolving sciences (such as molecular beam epitaxy) and supporting the manufacturing divisions with technical advice, coordinated literature access, the latest process technology, and in-depth material and device analysis.

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A Typical Cycle from Plan to Product ...

Your program begins with the "request for quotation (RFQ)" which outlines your product requirements, anticipated delivery and volume, and target price. After review by our technical and manufacturing staffs we will contact you with any additional questions. If we feel that Siemens can adequately service your needs we will submit a program plan, schedule, and quotation. This cycle is typically completed within five working days of receiving the RFQ.

Upon receipt of your order, we will jointly establish milestones and review dates for tracking the progress of your program. This will include a detailed listing of all key deliverables and evaluations, as well as points where reviews and decisions are required. At the end of the development phase of the program a final summary report will be submitted to complete your records and ensure a smooth transition into manufacturing.

How Do Siemens' Customers Benefit?

Successful development and production of optoelectronic devices requires many qualities. Your supplier must deliver:

A FIRM THEORETICAL FOUNDATION ... to guarantee that the latest technology and best equipment put you on the shortest path

to the solution,

STABLE PROCESSES ... to ensure that every step of the product evolution is reliable and reproducible,

FLEXIBILITY ... to provide the materials, processing, and degree of integration that are most performance- and cost- effective,

INFORMATION ... to understand how the device will perform in your application,

CONSISTENCY ... to expeditiously and reliably meet your product needs.

Siemens has been demonstrating these qualities for over 15 years. Whether it is an interactive development of a new product or volume production of an established part, we are the best supplier to service your optoelectronic needs!

Inquiries

Address all correspondence and telephone calls to the "Custom Materials and Devices" organization at:

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Materials Selection Guide

